Embedded Tech Trends 2014

**New EW architectures based
on tight coupling of FPGA and
CPU processing**

RF Sampling
behind antenna
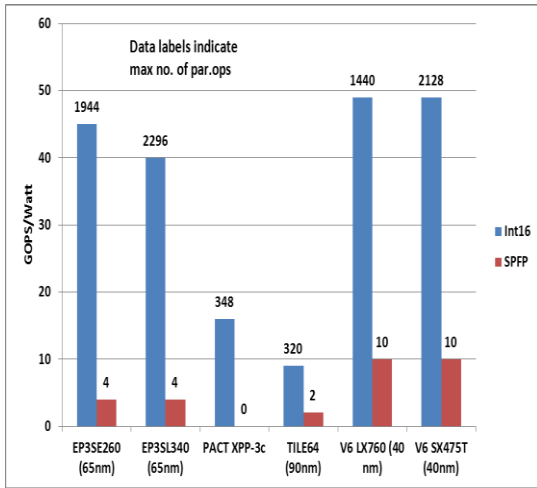
FPGA
LVDS capture
Processing
DMA transfers

CPU
Runs High speed
protocol stacks
for wide-area
network
connectivity

Low Phase Noise
Clocking
Multi-Channel
Synchronization

Low Power Parallel
Processing
Very high-speed
Transceivers

High-end processors
Wide-band on the backplane
Multi-Root Complex
Communication

Configurable logic devices
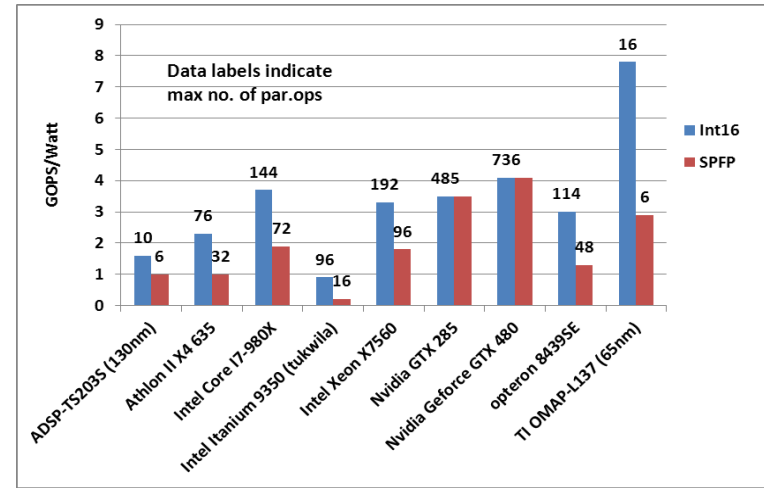
Fixed logic devices

A study financed by the National Science Foundation (Alan George, Herman Lam, and Greg Stitt - IEEE magazine Computing in Science and Engineering - Jan/Feb 2011)
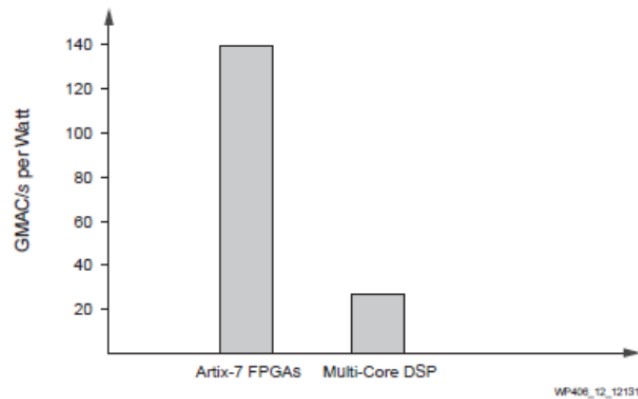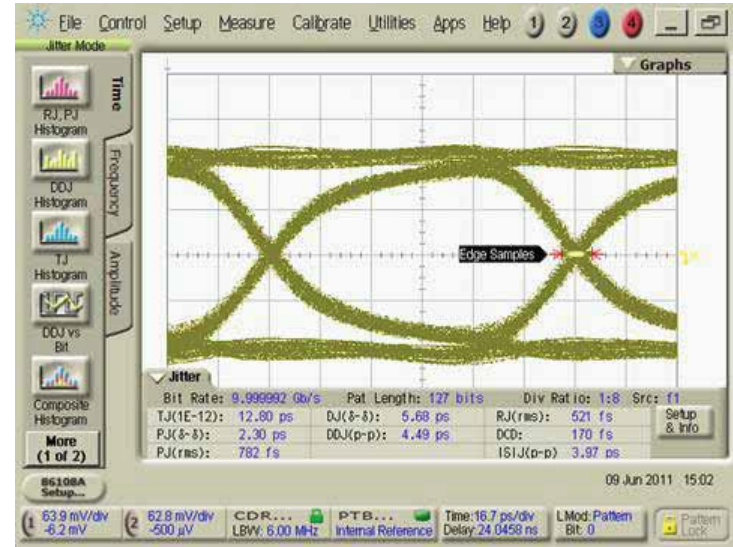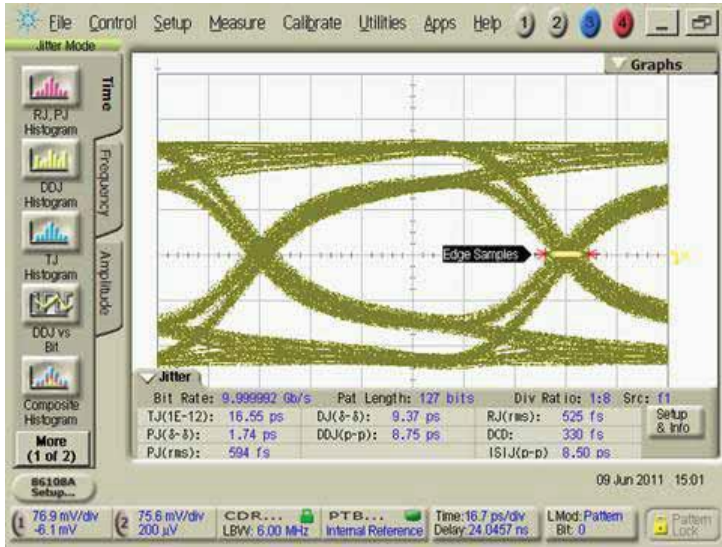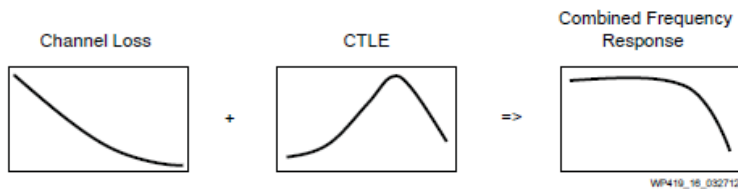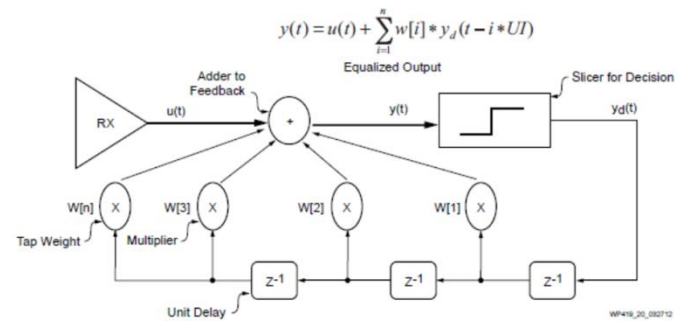

Figure 12: DSP Performance per Watt

http://www.xilinx.com/support/documentation/user_guides/ug479_7Series_DSP48E1.pdf

GTX Tranceiver 10 Gb/s Eye Diagram without (left) and with 2 dB post tap de-empahsis (right)

**Peak to peak ISI jitter reduced by more than two**


High-pass filter with
auto-adaptation

$$y(t) = u(t) + \sum_{i=1}^{n} w[i] * y_d(t - i * UI)$$

Xilinx Decision Feedback Equalizer (DFE)

Benefits of RF-Sampling

- A single direct RF-sampling ADC can replace an entire IF-sampling or ZIF-sampling subsystem of mixers, LO synthesizers, amplifiers, filters, and ADCs
- Reduction of bill of materials (BOM) cost, design time, board size, weight, and power.
- Analog frequency down-conversion function moved into the DSP, FPGA, or ASIC, where frequencies and bandwidths can be controlled digitally, enabling maximum system flexibility and re-configurability
- Example 4 channels at 1300 Msps 12 bit (1300 Mhz on the LVDS
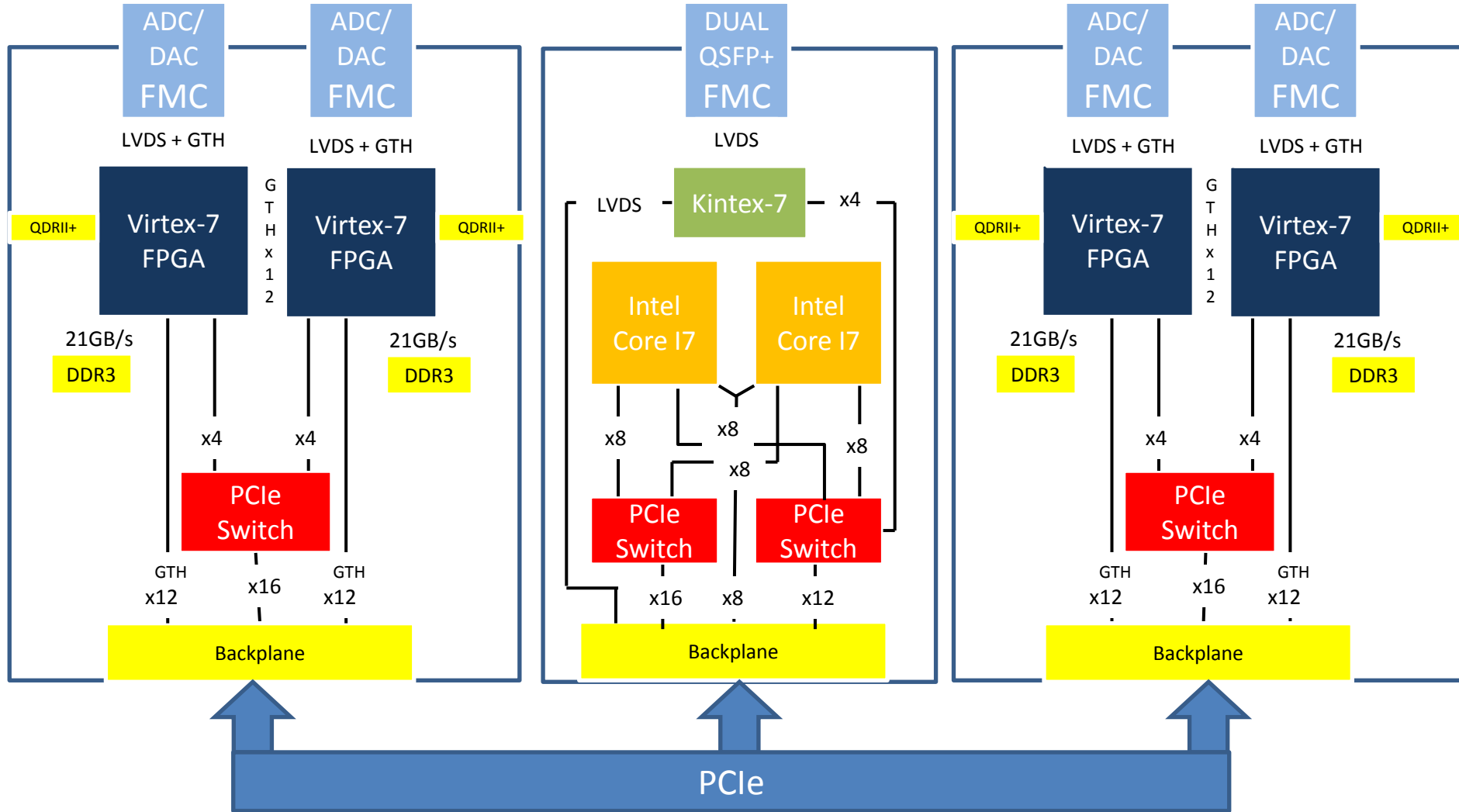- to Virtex-7)
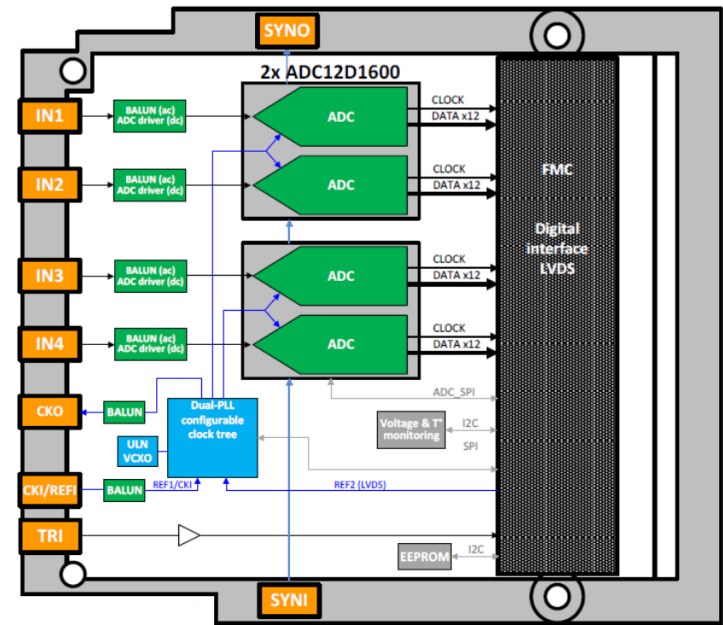
Example of

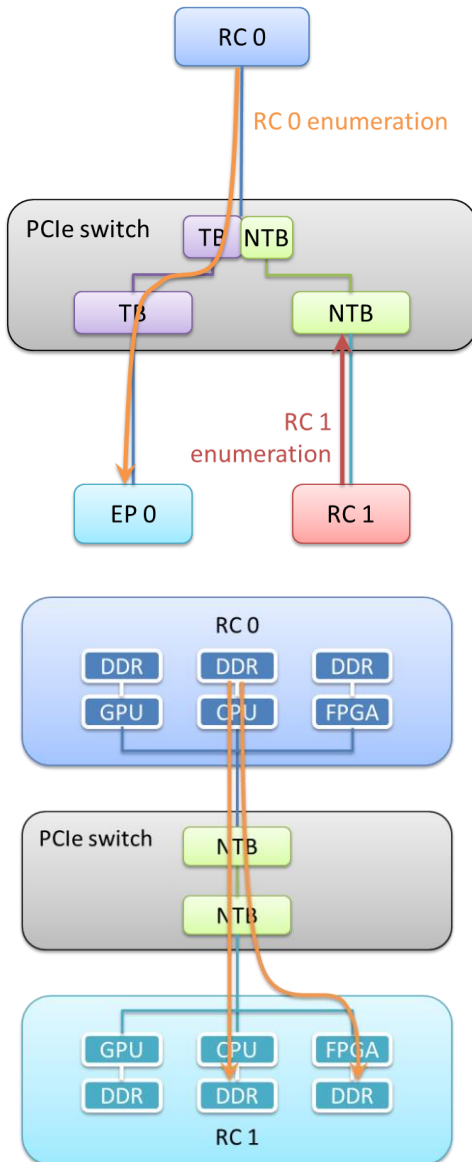RF Sampling ADC FMC
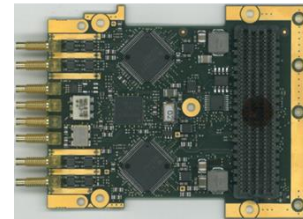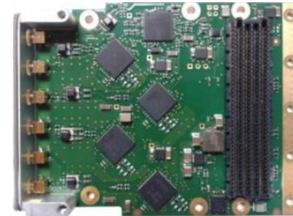
IC-FEP-VPX6b   IC-INT-VPX6a   IC-FEP-VPX6b

- **A PCIe domain is made of one Root Complex(RC), PCIe Transparent Bridges or switches (TB)and PCIe EndPoint (EP)**
- **A PCIe domain must not contain several RCs**
- **PCIe domains are interconnected through Non-Transparent Bridge**
- **NTB mechanisms for RC communication : Message boxes and Doorbells**
- **Use of MSI to generate interrupts on RC**
- **Data transfres from/to PCIe memory area (CPU DDR, Graphic DDR, FPGA DDR)**
- **Each RC configures its NTB access to the other PCIe domain**
- **Multicast : transfer same data from a PCIe memory area to several PCIe memory areas**
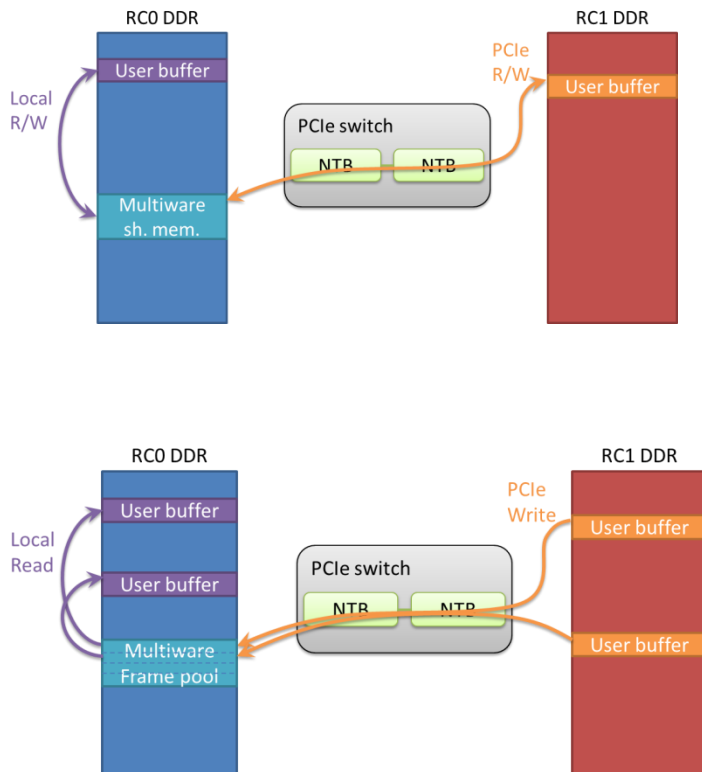
- **Software package : Configure and manage NTB hardware devices and provide simplified API for user designs**
- **Independent of the CPU architecture (PowerPC 32bits or 64bits Intel 32bits or 64bits)**
- **OS: Linux, VxWorks**
- **Memcpy: CPU transfers data through the NTB**
- **Platform DMA: Based on DMA OS API (Freescale SOC DMA, IOTA DMA...)**
- **NTB DMA: DMA in the PCIe switch**
- **Shared Memory Data Transfer**
- **Frame pool data transfers**
- **RC communication: Message transfers, events notifications, synchronization**
- **Information about local/remote RC**
- **PCIe device translation**